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(73) Proprietor: Al'tshuler Grigorij Borisovich

(54) APPARATUS FOR LASER TREATMENT OF BIOLOGICAL TISSUES
(ALTERNATIVE EMBODIMENTS)

(57) Abstract:

FIELD: medical engineering; surgery; orthopedics; stomatology. SUBSTANCE: proposed apparatus comprises at least one receiver of information about condition of biotissue to be automatically controlled. Receiver output is connected with input of control unit. Apparatus further comprises electronic switches arranged in current supply circuits of lasers and controlled by output signals issued by control unit. Finally, apparatus comprises two or three lasers emitting radiations at different wavelengths and having independent outputs. EFFECT: improved design. 7 cl, 5 dwgs

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(56) References cited:

WO, naTeHT, 90/12548, mu. A 61 N 5/00, 1990.

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(54) **YCTPOYICTBO J~JISI JIA3EPHOL1** OBPABOTKLI BVIOJIOP14^IIECKOLI TKAHII
(EPO BAPIPAHTbI)

(57) Abstract:

I'ICHOnb3oBaHHe: H3o6peTeHHe OTHOCHTCя K MeлlHL HHCKOли TexHHKe H MO}Ke'r *66ITb* Hcnonb3oнaxo B xHпыpHH, opTone **nu u** cToMaTonopнH. CynюoTb H3o6peTeHHc: aBTOMaTH^IleCKHe KOHTpOлb COCTOяHHя o6pa6aтлBaeMotи **6HOTKaHH H ynpanneime** напaMeTпаMH H3ны^Ileana на3epoa RocTUrалоTCSI 6нaroj;apsi CoBOKypHOCTH BBejjeHHblx B ycTpoficTna *xOTB* 6bl OJHOPo IlpICMHHKa HH4)OpMaIHH o COCTOяHHH 6HOTKaHH, BbIXOg KQTOporo coeчHeH c BXOjOM 6ноia **ynpasneHux**, H 9MOKTpOHhblx x.mofeлI, yCTaBOBJCHhblx B IjenSIX rHTaHHcI на3epOB H yнаBнnleMbix BbIXOJ(HblMH CH:HaHaMH 6ноxa yнpanneHHcI. Hanм^IHe B OAHOM yCTpOICTBe AByX HнH Tpeх на3epou c пa3TDX'mbIMH ,HнHHaMH BOTиH 113ny^IleHH2 H He3aBHCHMbIX BbIXOgOB, a TaKJKe B03MO}KHOCTb CMemXBaHHH H3nyeHHI 9THX на3epoB o6eчнeх-nIBaeT B03MO}KHOCTb TpebyeMOlo, OpHeHTHpOBaHHOpO Ha MHHLIMalbHlO HHBa3HbHOCTb пe}KHMa o6pa6oTKI. 5 yin.

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143BeCTHO, ¹ITO 9 4eKTHBHOCTh na3epHOH o6pa6o'rKN 6NonorxTlecxolz TKann C OTrHOBpeMeHHbIM o6ecne¹leHHeM H113KO2 NHBa3NBHOCTN (CreneHH HeKp03a) 3aBNCNT OT MINHbI BOTHbI N MOnLHOCTN na3epHOro N3nytleHHH, 3Heprnn N BpeMeHH na3epxopo B03TjelICTB4H, a Tjnh HCKOTOphIX BNTJOB TKaHH4 zKNTjKOCTHOro OpomeHHH 30HbI na3epHOLI o6pa6o'rKN (cM. HanpNMep Proceeding of. Laser-Tissue Interaction V 24-27 January 1994. Los Angeles, California Vol 2134A).

NccnegoBaHHH, npoBeJeHHMe anToM, noxa3anL, wro npN 9ToM Heo6xoJNMa OT(HeBpeMennaB OnTNMM3a1I 1st yKa3aHHbIX napaieTpoB A SR Ka c opO Bill a 6NOTKaHN. I4HbIMN CnOBaMN, He0XOT(HMbI: BO3MO}KHOCTh Bb160pa OHTNMaJlbHbIX MIIIH BOMH N3ny¹leHHn na3epo rum Nx CMedy, perCTpaunH npocecca na3epHOTi TjecTpyKB;NH, BNTja N COCTOHHH 6NOTKaHN N ynpaBneHLH TjnlHOLI BOHbI, MOIIWOCTbIO, 9HeprLe2 N BpeMeHeM na3epHoro TgeicTBN51, cHcrema OpoineHHH 3OHM na3epH01¹ o6pa6OTKN.

COBOKypHOCTb BBeJeHHbIX B yCTPOLICTBO XOTbI 6bI 0,14HOro npaeMHNKa 14H4OpMaljLH o COCTOHHHN o6pa6aTbIBaeMOa 6aonorHecxon TKaHN, BbIXOTj KOTOPOPO COCTINHeH c BXOgOM 6noKa ynpaBneHHH, N 9neKTpOHHbIX Knloue2, ycTaHOBJeHHz 1x B ijemix niTaHHH na3epOB N ynpaBneMbix BbIXogJI IMN cllpHanaMH 6noKa ynpaBneHHH, npe)jcTaBnHoT co6ofl CNCTCMY o6paTHoi CB513N, KOTOna1 o6ecneHHBaeT an'roMaTN¹lecKHe KOHTpOJb N OHTNMaJlbHOc ynpaBneHHa napaMeTpaMN Harly¹leHHH na3epOB B 3aBHCNMOCTh OT BNTja N COCTOHHH o6pa6aTbIBaeMO2 TKaHH N 'rem CaMbIM o6ecnewBaeT MNHHManbHyio HHBa3NBHOCTb.

Heo6xoJ aMocTb aBTOMATH¹lecKHX KOHTpOJcI N ynpaBneHHH BbI3BaHa¹ TaCTO B03HNKa1011jeH HeBO3MO}KHOCrb10 B143yabHOPO OnpCTjeHeHHH Bpa¹OM COCTOHHH o6nyTaeMOi TKaHN N ee BNTja.

Hanatlae *τ;Byx* HC31311CNM:1X BbIXOT(OM B OT;HOM yCTPOICTBe 6napoTjapH H03M07KHOCTh BbIBOTja OTpa}KaTenbHOPO 3epxana 143 xOT(a 113JlytieHN51 Ilepnor0 na3epa, a TaK}Ke BO3MO}KHOCTh CMeuLBaHHH 143JlyUCHN2 TjByX na3epOB IOBbIHaeT 9(4eKTNBHOCTb pa6OTbI ITN o6pa6oTxe 614OTKaHN N o6ecne¹mBaeT CHH}KCHHe HeKp03a -

HanatlNe B OT(HOM yCTPONCTBC T(n51 06pa6OTKN 6NonorrmecKo2 TKaHN TpeX na3epOB c pa3n¹HHbIMN T(fNHaMN BOJH N3ny¹leHHH N He3aBHCNMbIMN BbIXOT(aMN II c BO3MO}KHOCThIO CMenIBaHHH N3ny¹leHHB o6ecne¹laBaep HaN6OHyIyIO M06NJbHOCTb npaMeneHHH yCTPOLICTBa N MaKCNManbHO pacmJapHe' ero B03MOXHOCTN. HanpIMep, npN OTjHOBpeMeHHOM B03}2eICTBHN OnbMHeBbIM H HCOTJNMObbIM na3epaMN Ha o6NnbHO KpOBOLIacbinjaloume opaHbI CHNMaeTCH OnaCHOCTb KpOBOTe¹leHHH npN HeCaHKILNOHNpOBaHHOii nep4opalj1N KpyHHbIX KpOBeHOCHbIX COCTaB. MIA CMeUINBanSI N3ny¹leHHH TpeTberO na3epa c T(ByMH T(pylMN Him Ka?KT(b1M 143 MUX BBCgCHbI OTpa?KaTenbHOe H ceneKTNBHOe 3epKana, ycTauoBneHHble COOTBeTCTBHHO K OCSIM TpeTbCrO N DTOPO 11a3epOB, a BO3MO?KHOCTh BbIBOTja OTpaKaTCTbHbIX 3epxan N3 XOTja 11311y¹ICHN51 14 Han1gle T(ONOTIH14TC11bHbIX ~OKyCNpy1On)ITX CNCTeM H OHTN¹TCCKIX B0TIOKOH o6ecne¹rDaeT lie3aB11CNMOCTb TpeX OHTN¹lecKHX BbIXOT(OB yCTPOICTB.

AOIOJHHTenbHO BBe}CHaH B yCTPOLICTBa CHCTeMa OpoineHHH, ynpaBneMaB 3nCKTPOHHbIMN KllanaHaMN, IOT(Kn1O¹leBHHIMN K BbIXOTjaM 6nmKa ynpaBneHHH, o6ecne¹lnBaeT onTNManbHOe coreTaHe ne?KHMOB o6nytleHHH N OpOHeHHI TKaHN.

COBOKyIIHOCPb N3n02KeHHbIX B 4 opMyne N306peTeHN31 npl3HaKOB HBNHeTCH HOBOJI, a canto TexHN¹lecKoe pemene yTIOBJICTBOpICT Kp1TepcI10 "14306peTaTenCKNLI ypOBebH".

Ha Ipar.1 N306pa?KCHa CXeMa ycTpoiicTba Tjns na3epuo i o6pa6oTKH 6NotKaHN; Ha 4Nr. 2 CXeMa yCpOLICTBa npN Hana¹n4N TpeX na3epOB; Ha (MP. 3 CXeMa BapHaHTOB BbINOJHCHH II pacnono2KeHHH npHeMHKOB NHd opMaluNN o COCTOHHH o6pa6amIBaeMO2 6NOTKaHN; Ha tMr. 4 cncTeMa opoieulln 30HbI o6pa6oTKN; Ha (DNr.5 6nox-CXeMa 6noia ynpaBneHHH.

VCTPOLICTBO anH na3epHoi o6pa6OTKN 6nonorH¹lecaoik TKaHN 4Nr.1) COCTONT 143 6noKa ynpaBneHHH 1, COe, (NHeHHOro c H14M 6nox nsTaHHH 2, NMnyhbCHbIX na3epoB 3, 4, cocj HHCHHbIX c 6YOKOM nITaHHH¹iepe3 3neKTPOHHble KnlO¹IN 5, 6, KOTOpble no KnlO¹leHHbI

К BbIXOgaM 6ноха ynpaBneHHn 1. Ha onTLIuecKnx coax naoepoB **3, 4** pacnono?xeHbl CoOTBeTCTBeHHO OTpalKaTenbHOe 3epKaJIO **7** и CeneXTMBHOc 3epKaJIo **8**, KoTOple onTHuecKII conpH KeHbl MelKgy co6oa **с** (poKycHpyionjeLI encTeMoh 9 H BbIXOgHbIM TOPIOM OnTHueCKOpo BOJIOKHa **10 с** HaKOHе 'HHKOM **11**, pacnon07KenHbIX Ha OITMUP.CKO\$ oCH na3epa 4. CeneKTИBHOe 3epKaHO 8 oTpaJKaTeTbHO gnsI H33Iy'ieHHn C gTИHHOI BOnHbl na3epa **3**, no npo3patuo Rnn H3nyeHnn c gTHHO\$I Bonn i na3epa 4. Pacnono}KeHHoe Ha OITHueCKOII OCH na3epa **3** oTpaJKaTenbxoe 3epKaHO 7 nOgKpИOueHO K BbIXOgy 6ноха ynpanneHnn 1 H B 1101102KeHHM A ycTanaBannaеTCn nog yrhoM **45°** x ocil, a B non0xeHHD1 B napanneim o eft. Ha 9TOLI lice oCH ncneg **3a** 3epxanoM nocnejjioBarenbHo no xony M3nyeHHMH pacnonozeIn 1 4)oxydHpylonjan cneTeMa **12** n onTHuecxOe BOTIOKHO **13 с** HaKOHеuHHKOM **14. К** BXOgy 6ноха ynpannenHH 1 nogxmo^geH 3neKTpnueCKHI BbIXOA npHeMHHKa HH(popMaHy 1 o COCTOHHHM 6HonnnecKoИ TKaH1 15, BXOg KOTOpo COIIpHHTeH c MeCTOM B03jjeICTBИH Ha 6ИOTKaHb 16. CHCTeMa nppnax nzi **17** no)IUnIOyexa K TeM KC BbIXOJaM 6ноха ynpaoneHLIcI 1, 4TO 11 6nox nHTaHHH 2, a ee Bo \$HOYi n Bo3,ByIBHb11 BbIXOgbl 18 M 19 o6'begmneHbl B HaKOae 'HMKе 11 (14).

Ha (Dnr. 2 npegcTanneH BapHailT ycTpOICTBa c TpeM\$1 na3epain 3, 4, 20. Ha onTz1 ecKovi oCM na3epa 20 ycTaHOBneHO oTpalxaTenbHOe 3epKaHO 21, KOTOpoe Tax Me, Kax H oTpalKaTenbHOe 3epxano 7, nogKnoueHo K 6nOxy ynpaBneHlin 1, H B non0KCHHH A yC'paHaBnHBaeTOH nog yrhoM 135° K onTHueCKOII OCH, a B HOnOJKeHHM B - napan.nenbno eLI. Ha 9TOLI lice onTИuecoИ oca pacnonoJKeubl 4)OKycHpylonia\$ cHCreMa 22 H BXOgHOLI Topeu OnTHueCKOpo BOJIOKHa 23 II HaKOHеuHHKOM 24. MewK,ny (poKycHpylonjeLI cHCTeMoI 9 H CeTeKTHBHbIM 3epxanoM **8** ycTaoBneHO BTopoe ceneKTMBHOe 3epKaHO 25, xoTOpoe onTMueCKM ConpH?KeHO **с** 3epKaJIOM 21, (poxcHpylonjeIK CHCreMOLI **9** n BXOgHbIM TOPI(OM OnTHueCKOpo BOnOKHa 10. CeneKTИBHOe 3epKaHO 25 OTpalxaTeJbHO grin n3JTyeHH31 C gnHHOLI BOfHbl na3epa 20, He npo3paLHO grin H3nyUCHLI C gTИHHaMH BOJИH na3epOB 3, 4. BnoK rHTaHHH 2 coegИHeH **с** na3epoM 20 uepe3 9neKTpOHbИИ KpИOy 26.

Pa3HOBIHOCT\$MH npHeMHHKa ИHTИOpaMaJLIM 15 o COCTOHHHM 6HOTxaHH 16 MOpIT 6HTb KaK CneKTpOaHanH3aTOp 27 (4nn'.3), BXOg KOTOPOpO OHTIZueCKH conp51 KeH c MeCTOM B03geICTBИH Ha 6HO TKaHb 16 H COCTOHH(HLI 143 gHCnepCMOHHOPO 9JTeMeHTa 28, nHHeIKH 44OTOgeTeKTOpoB 29 II 9JICMeHTa CpaBHeHHcI 30, TaK H (pOT09TICKTpWueCKMLI npHeMHHK HH4ppaKpaCHOpo H3nyeHHM **31**, OITИueCKИ4 Conp\$ИKeHHbИИ **с** MeCTOM B03geICTBИH Ha 6ИOTKaHb 11OCpegCTBOM OnTH'leCKOpo BOTIOKHa 13 (10. 23), (poKycHpylonjeLI CHCTeMbI 12 (9, 22) II fOBOpOTHOpO 3epKana 32, pacnono KeHHOpO Mcлцpy 4 OKycHpyloueи CHCTeMOИ 12 (9, 22) H 3epKaHOM 8 1JИH nenocpegTBeHHO nepeg BbIXOgBbIM 3epKaHOM na3epa 3 (20). llepeg OnTHueCKHM BXOgOM (4OT09neKTpИueCKOpo npHeMHHKa 31 ycTaHOBneH MH4paxpacnbИ 4pHnbTp 33, nonoca np0nyCKaHHH KOTOPO nCKHIOyaeT nonagaHne Ha 4)OT03neKTpИueCK11 npHeMHHK 31 143nyeHHcI na3epa. B KaueCTBe npHeMHHKa HH4opMaцИИ 15 o COCTOHHHM 6HOnOpH TeCKON TKaHИ 16 *мoJкст* 6b1Tb И aKycTHueCKHИ npHeMHHK 34, paCn0n02KeHHbИИ 1161111311 MecTa BO3geLiCTBMn Ha TKaJlb TaK, 'ITO HanpaBpHeHepo MaKCMOJbHOИ UyBCTBHTeHbHOCTH COCTaBpИeT **с** onTMueCKOLI **00,10** H3nyeHH51 Ha BbIXOge HaKOHеuHHKa 11 (14. 24) ypon a, ne nanyuИ B npeganax oT 11 go 86°.

В CBИ3И **с** TeM, **ITO** MHCJIO npHCMHИKOB HHd)OpMaUMH o COCTOHHИИ 6HOTKaHH MOKT KOne6aTbCH OT OghOPO go гCBHTH (nO Ka?KгOMy BИJy, OKOMO Ka2KгOpO HaKOHеUHHKa), KOpИUCCTBO BXOJIOB 6ноха ynpaBneHnn *мoткст* 6b1Tb paBHO геBHTH.

CMCTeia opomeHnn 30x.1 06pa6OTKH 17, M3o6paxceHHaH Ha 4)ir.4, COCTOHT 143 пe3epnyaapa grin BOgbl C BOgHHbIM HaCOM 35, x KoTOpOMy npMcoegMHeHa BOg0npOBOJИaH Tpy6Ka 18, n B03gyIIIHOpo xoMnpeccopa 36. RpHCOeyHeHHble K B03gyIIHOMy KOMyпeccopy 36 B03gyXOnpOBOgHjMe Tpy6in 19 CHa62KeHbl 3HeKTpOMarHMTbIMM xnananaMM 37. 38, 39, xoTopи ie nogJИoueHbl K TeM lice BbIXOgaM 6ноха ynpanneHnn 1, yTO H 6n OK nMTaHMA 2,tlepe3 nHHH 3agepxcИn 40, 41, 42.

ycTpouCTBO pa6oTaeT CJИeponjHM o6pa3oM. I43JИyеHnn na3epoB 3, 4, 20. B cnyvae HaXOJKeCHM51 OTpalKaTenbHbIX 3epxan 7 M 21 B ИOn0KCHHH B, npoNgi (4OKycHpylonje CHCTeMbI 9, 12, 22, OnTгeчeчe BonoicHa 10, 13, 23 M HaxOHеuHHKM 11, 14, 24 nocTynaIoT

Ha OUTH¹leCKMe BbIXO)TbI yCTPO ICTBa.

Ecnn OTpa?KaTenbHble aepxana 7 H 21 HaxO 5xTCa B HOTIOncHHH A, H3Tly⁴leHHe na3epa 3, OTpa3HBIUIHCb OT 3epxana 7, nonaJ aeT Ha ceneKTHBHoe 3epxano 8 H, oTpa3H iimeb OT Hero, Hanpannclercn ngonb onTH¹CCI o l oCH na3epa 4. A Hanorntnio. npH HanxtmL na3epa 20, H3nyeHHe na3epa 20 OTpa3HBIIMCb OT 3epxana 21, a 3aTeM OT CeneKTHBHOrO 3epxana 25, TaK%e HanpaHneTcs BJJonb OHTI ecKO11 ocn na3epa 4. B pe3ynTaTe, B CBH3H co CBOLICTBOM CeneKTHBHbIX 3epKan 8 H 25, B 4OKyc **ipyIondlo** CHCTeMy 9 H Ha OHTH¹leCKH5 BbIXOJ HaKOH¹nn3Ka 11 MOpyT nOCTynaTb H3ny¹leHHH **BMX** TpeX na3epOB OJHOBpeMeHHO.

Bb16op BHAa npHemnmxa HH4)OpMaw n 15 o COCPOHHH 6HOTKaHH 16 3aBHCHT OT BHga TKaHH H pe2KBMa o6pa6oTKH, a TaIQKe OT BHJa HaKOHetHHKa. 11pn pa6oTe c HeKOHTaKTHbIMH HaKOH¹niHKaMM OCHOBBaH MacTb B3Jly4HHH 3p03HOHHOpO 4 arena, B03HHxalolJero H3-3a cBe¹leHHH ygameMbxx ¹acTm 6HoTxaim, ne7KHT B BLIJ(HMO5 H 611HIKHHX ynbTpa4)HOneTOBO5 H HH(DpaKpaCH05 06naCTHx cneKTpa (200-1500) HM) H HBTICleTCSI npH¹inHO5 HeBO3MO?KHOCTH BH3yambHOpO Ha6nlo)(eHas BHga H coCTOHHH 6HOTKaHH.

CneKTpanbHbIJ COCTaB H3Tly¹leHHH 9p03HOHHOpO (arena 3aBHCHT OT BHga 6HOTKaHH, IOOTOMy Heo6Xo/ HM CneKTpaHbHb15 ¹aHaITH3 3TOpO H3Tly¹leHHH, KOTOpOe nonajjaeT Ha gHCepCHOHHbnil 9neMeHT 28 CneKTpoaHanp3aTopa 27, paanaraeTCH B cneKTp H nonaJjaeT Ha nHHeIKy 4OTOJJeTeKTOpOB 29, cocI HHeHHJO c 3nCMETOM CpaBHeHHH 30. YpoBenb BbIXOgHOpo 3neKTpH¹leCKOpO CHrHHana 3neMeHTa cpaBHeamn 30 COOTBeTCTByeT KOHKpeTH0171 KOM6HHaIH H JnHH BOYIH CneKTpa H3ny¹leHHH 9p03HOHHOpO 4aKena. BneKTpH¹leCKHil CHrHan OT 3neMeHTa cpaBHeHHH 30 cneITpoaHanp3aTopa 27 nocTynaET Ha 6nox ynpaBneHHa 1, r r a Bb1pa6aTbIaeTCH CHrHan H3MeHeHHH pexcMMA H napameTpon H3nyeHHH na3epOB.

Pa6oTa c KOHTaKTHbIMH HaKOHetHHKaMH CBH3aHa c HarpenaHHeM na3epHbIM H3ny¹leHHeM Toplia pa6oiero HHCTpyMeHTa (BOTIOKHO HnH can4 LpoBbIl HaxOHennmx) JIo TemnepaTypbl, JJOCTaTO¹HO5 JnH pa3nyHeHHH 6HOTKaHH. HarpeB MecTa Bo3JJeLICPBHH OnpOBOMR aeTCH B03HHKHOBeHHeM HHcpaKpaCHOpo H3Jly¹leHH53, KOTOpOe nepejaeTCH HO BOTIOKH HaKOH¹HHKa 11 (14, 24) H OHTH¹leCKOMy BOJIOKH 10 (13, 23) B HanpaBneHHH, O6paTHOM XOJy 1Ja3epHOpo H3ny¹leHHH, OTpacaeTcT OT HOBOPOTHOpO 3epKana 32, npoxoJHT HH4paKpaCHbI2 JIHbTp 33 H nonaJ aeT Ha 4oTo3neKTpx4eCKHIL npxeMHHK 31. 9neKTpHeleCKH5 CHrHan c BbIXOJJa 4 OT03neKTpH¹leCKOpO npHeMHHKa 31 nocTynaET B 6nOK ynpaxuemmn 1, r)je B 3aBHCHMOCTH OT HapaMeTpoB 9TOpO CHPHana Bb1pa6aTbIaeTCSI CHrHan OCTaHOBKH, npo on?KeHHH H1IH H3MeHeHHH peaczMa pa6oTbI na3epa.

3KcnepHMeHTaHbHO yCTaHOBeHO, 4TO TenIOBOe H3Tly¹leHHe, Bo3HHKaIOJlee npH pa6oTe c KOHTaKTHbIMH HaKOH¹HHKaMH, Haxo wren B rny6oxo2 IH(ppaKpacHon o6nacTH. B 9TO2 o6nacTH nyBCTBHTCJbHOCTb 4)OT03neKTpB¹leCKHX npHeMHHKOB o¹ICHb Mana. CneiTpanbnaX o6nacTb H3ny4eHHH na3epOB Taxxe nexciT B HH\$paXpacnoirt o6nacTH. 11o3TOMy nonOCA nponycxaHHSi HH4 paKpacnopo I:DHbTpa 33 cnaconana co CneKTpanbHO2 ¹lyBCTBHTeHbHOCTbIO 4 OTOnpHeMHHKa 31, c OKHOM Hp03pa¹HOCTH onTHgeCKOpO BOYIOKHa 13 H o6ecnetlxaeT HcKnlotixue nonaJjaHHH Ha 4 oTonpxexwmK 31 H3ny¹leHHH na3epOB 3, 4, 20.

11popyKTbi nazepHoro pa3nyeHHH 6HOTKaHH pa3neTaloTCH co CBCpx3ByKOB05 CKOpOCTbIO, L B CneJCTBHe peoxopo H3MeHeHHH AnneHHA H3-3a conpoTHBneHHH cpejbl rexeppxyeTCSI axycTHlecKas Bonn-Ia. Ann pa3TH¹HnmIX TKaHC5 awnnwTyga aKyCTHMeCKOLI BOHbI paalzH¹lia. AMnnwTyJJa axycTmneCKo2 BOJHbI perHCTpHpyeTCH aKyCTHHeCKHM npxeMnino 34, 3neKTpi¹leCKHiiJ CHPHan c xoTopopo nOCTynaET Ha 6nox ynpaBneHHH 1, r)je cnHTe3HpyeTCH cmrHan BpeMeHHOLI OCTaHOBKH H3Jly¹leHHB MHH H3MeHeHHH pen xi a pa6OTbx na3epa B 3aBHCHMOCTH OT THna o6pa6aTbIaionUeic TKaHH HnH B cnytlae npeHbneHHH 3HeprHH na3epHoro HMnynbca Hag nopOrOM paapynieHHH 6HOTKaHH, tITo BnxSeT Ha CTeneHb na3epHoro HeKpo3a.

11pexameHHe B cnytae Heo6XOJ14MocTH pexcxMa H3ny¹leHHH na3epOB B COOTBeTCTBHH c

cHlrHanaMa CnexTpoanann3aTOpa 27, 4oT09neKTpaUecKOPO Hna axyCTHuecxoO npHCMHHKOB 31 H 34 npOHCXOJ(14T c HOMOnjbio 6BICTpoge cTH3lonigx 9JICKTpOHbHIX Rummell 5, 6, 26. CHrHan c 6noKa ynpaBneHHc 1 nogae'rm Ha ynpaBnmom;nil BXOjj 9TieKTpoaHOo Knloua 5, (6 26) pa3MaKacI gem, nHTaHHc xa7Kj(Or0 H3 na3epoB. IlpexpanjeHne HMnynbca H3ny¹ICHHR 9 CKT14BH0, eCrIH BpeMci OTKijOuCH14SI miTaHHc McHbme jITHTPaIbHOCTH HMnyJmca H3nyeHHc. (AnwTenbHOCTb HMnybca H3nyCHHR M07KCT 6bITb 150-500 i c.). 1109TOMy B KaecTBe 9neKTpOHHOo Knloua J ovi KCH HCIOYIb3OaTbCSI 9nCMCHT c BbICOKHM 6bICTpor etteTBHeM. Taxman ynpaBneMbnmm xnlouaia SHEITMo'r `si nOTIynOBOJInIKoBble HRH 9neKTpOBaxyyMHble nepexlouaTenH, BpeM5 cpa6ammaHHc KoTOpbx He npeBbIIIaeT 100 Mice.

OpomeHHe 6HOTKaHH c HOMOIW,IO eHCTCMbi 17 npoHCXOJ ITT cnepyx►ng4M o6pa3oM. 143 pe3epHyapa jInCI BOHbl c BOjHHbIM HacocoM 35 Hog a 3anonHcic'r BOJ(onpoBo) single Tpy6KH 18. B cnyae Heo6xoJjaMocTH opomeHHc TKaHH CHPHaHbi H3 6noxa ynpaBneHH 1 IOCTynaOT Ha 9TCKTpOMaIHHTHMI KnaHaH 37 (38, 39), KoTOpbli oTKpbinaeT nOCTynneHHe Bo3pyxa nOH HaBneHHeM H3 B03JyHHOPO Koinpeccopa 36 B B03JyXOnpOBOH 19. KOHII .I BOJ;o- H Bo3pyXOnpOBOJcIH,HX Tpy6OK 18 H 19 paCuOn03KeHbi B HaKOHe'HHxaX 11 (14, 24) TaK, ¹TO noCTynneHHe BOHbl Ha HppHranFioHHbie BbIXOjhl yCTpOIITBa HpOHCXOJ ITT npH nojja'ie Bo3pna no npIHU,HIry IlynBepa3a'ropa.

CHrHanbi H3 6noKa ynpaBnemui 1 noeTynaloT Ha 9RCKTpOMaPHHTHbIC KnaHaHbi 37 (38, 39) uepe3 nHHHH 3aHCp2KKH 40 (41, 42) OjHO6pCMCHH c CHrHanaMH 3anycKa LIMIIynBOB reuepagza na3epoB 3 (4, 20).

OpolneHHe 6HOTKaHH BOJ OIII) OWKHO npOHCXOJ 11Tb B npOMC}KyTKaX Me}KJy HMIIynCaMH H3TiyehHc na3epoB (c genbio H36excaTb HeKCenaTellbHOe pacceIHHe H3nyeHHR H IOBbICTb 90ieKTHBHOCTh OpOmeHH), n09TOMy JInHTenHOCTb BpeMCHH 3aHCp2KKH RHHHLI 3ajjepcxKH 40 (42, 42) paBHa BpeMeano JWHTenHOCTH HMnynBOB H3Jy¹TeHHR na3epoB c yueTOM BpebHH noczylbleHHc B03JL Xa K KOHgaM Tpy6OK 19.

IIpHMep KOHKpCTHOLI peanH3aIHH 3aRBnsreMbIX yCTpOICTB COCTOHT B Cnejjy01IjCM. BTIOK ynpaBpeHHR 1 (4Hr.5) COCTOHT 113 yCUIHTCT H BXOjHbIX CHPHanOB c HHTerpaTOpOM (CM. IBIaCneHHKOB B.B. CHOTHH A.II. "LI36HpaTenbHble RC yCHRHTenH M. 3HeprHR, 1980, cTp. 69) BOCbMHKaHanbHOPO JjeCHTHpa3pSIjHOo aHaTIOPO-11W pOBOPO npeo6pa3oBaTenn (ALM) c nocneJjoBaTenbHbIM HHTeptDe2COM max 192 cepHH (CM. KaTanop MAXIM 1993), npogeccopa PC-104 c KBapTeBbIM renepaTopOM (CM. KaTanop KoncoplayMa Advantage real time devic AMPRO, 1993 cTp. 103-184) H BOCbMHKaHanbHOo TpeHHaJjraTHpa3pSI HOo IIudipallanoroBoro npeo6pa3oaaTens (LLAI) c nocneJjoBaTenbHbIM HHTept4el7lcoM max 540 cepHH (CM. KaTanop MAXIM 1993). BbIXOjHble CHPHanbi LLAI ¹BTICNOTCp BbIXOjjaMH 6noxa ynpaBneHHc 1, no TpeM H3 KOTopbIX, KpOMe CHPHanOB 3anyCKa HMnynBOB renepagaa, IOCTynaOT CHrHanbi, onpejjenRomyio BCnIIIIHy 3HeprHH Ha KOHTenbHbIX KOHJ;CHCaTOpOB 6noxa nWTaHHR 2 (CM. BOPKOB 14. B. ¹/ICTO¹HHKH nHTaHHR na3epoB", TexHHKa, KHeB, 1976, cTp.118).

B Ka²ecTBe na3epoB Hcnon3yioTcs na3epbl: Nd:YAG (JInmHa Bonnbi 1,06 maim Hna 1,32 MKM, Ho:YAG (i rmna BOYHbI 2,09 MKM) H Er:YAG (jVmHa BOnlibi 2,94 MKM). B KaecTBe J;HCnepcnoHHoro 9neMeHTa 28 CTCKnsHH 51 npH3Ma, B xaecTBe 4oTogeTeKTopoB 29 KpeMHHeBble IOHynpOBOJHHKOBble (OTOjHOHbi 441-256, a B KaecTBe 410T09neKTpHuecKOPO np14eMHHKa HHd)paKpaCHOo 113TiyehHR 31 repMaHHeBbn7i 4poTj Ito) ¹I -9. 9neMeHT cpaBHejIHC 30 MHKpocxeMa K554CA3 min LM-111. AKycTHuecKH7i np14eMHHK 34 MHKpoOH B K4138.

Tatum o6pa3oM, npegnapaeA,Ible ycTpoICTBa 3a CueT c0BOxyIIHOCTH 3annncieMbIx npa3HaKOB, o6ecneLIHBan onepaTHBHoe ynpaBneHHe c B03MOHKHOCTbIO BapbHpOaHHR B IIHpoKOM jIlana3oHe napaMeTpaMH na3epnoro 113TiyehHR, H03BOnRIOT npOBOJHTb xapyprHuecKHe npogepbl Ha 6HOTKaH\$X B KaecTBe nH6o CKanbnens, na6o KoarynsTopa, nH60 jjeCTpyKTopa B 3aBHCHMOCTH OT Tpe6eMbIX THPOB, pe7KHMOB H cogeTaHn paOTbI na3epoB, OpHeHTHpOaHHbIX Ha MHHHManbHyIO TpaBMaTH4HOCTb npH JjaII40M BHje B03Jje2CTBHR Ha jjaHHyJO 6HOTKaHb.

'Eda£EU uHHahAU£Lt
 XHHMIIdu EH aHHE11E11011 LI31HOteHOfux3H 'ISHHExaAUOdu 1103olrou 3 d.L9un4 £adah
 'aol L3H3 aalnoadn3Axo(l R ad3£EU kouaudaf L4I9H1fOx19a 1O1xrat4 Eda£Eu H3o bloxoahH.LUo
 EH o.IOxxaxrououoad 'Euaxdaf o.IOH.LOdoau YQOa,L311'adaou 9HE31.1, EH £Ha.L3Ha1£foa 140,13314
 3 ISHH331CISd1O3 Oa03133hYLL110 untf H3HLIOU19a O.Iodo.Lox lioxu '1SHH3hA11£H ouon3Ed)Ed(oIH
 ExMHN314d11 o.IOx3ahxdJ.xaueo,LO(1 3Y1Ha a H3HU0119a HHEX,L HO3133hL1O110H9
 11HH10.L3O3 o HHYIENdO(t)HH MHHI43HdU O,Lh 'r13,L IS3331HOEhaU.LO 'g H run OU oa.LOLIOd.LoA 'l7

'axH3HaEd3 E,LHoI4aus
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 EH ISYia.L3pul£Oa NO,1,331 3 ISHH33KUduo3 0.103133h1A.1,110 ISU11 H3Hfou19a oJOdO.LOM t10Xa
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 HHHUO.L303 o HHIEL4d0((1HH xxnnaadu o,th 'Ysa1 u3331uorEhHU.1,0 'g H 1'1111011 oELLagod.LaA -c

'HVIHE.LHH P10140U9 3 Eda£EU Oa01131cEx xHH31114t13o3 Xxn311 a XI£HHaua0HE1a1f '£g3o11131
 x19HHOd.Lx31Ie Nioltoxiaa 3 ImHaHHd3o3 oaodo.Lou i lox19a 'uaH3uaaduA Ex0119 P10110Xa
 3 H3HR11303 1lox19a a 'max., EH HHa,L393r£fOa 140.L331AI3 ISHH331CISdu03 untf I3H1101119a
 oaodo.ox r oxa 'Hnan.L 9O3133hH.JOUGH9 HHHISO.LO03 O HH'TENdO(PHH P0NHHN3Hdu auto
 1'19 HLOX 03101E.L Oa0HH33x9EH3 'Ea.L390d.L3t£ Hl4at1oxIga HPIH3133hH,LU0 HYSHJAd11 xaL01ISUau
 xI9d0.LOX 1911oxia 'Y1031HHh3H0nEH 3 OH3IOU0a 30x33hH.LUO H EYJ3.1,axa 1SE1UOxAdH3A3I04
 I9Haxrouou3Ed xauahAu£H 14lox ou on9ua.Laootalraou aoda£EIr oaa9.Lad.L H oaoadau
 14300 £H H0t3KE31 EH '0.101, aI^Iodx 'Macau o.Iodo.La 113o EH x19InH331CO110u3Ed 'EI310110a
 0.I03133hH.LUO PI0110xa H HOYZ3.Lox3 HatnoxAda3Aao4 'ada£Eu o.Ia9L3cLL aoo 90x33hH.LUO
 EH Nu9HHaila0HE.L31C 'nouexdaf 14t9H9u3J axred.Lo a oHH331Cudu03 H313ahH.L110 'oL£exdaf
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 Ef adacau oaodoLa 1130 HOx33ha.LUO Elt E 'HHH3hAu£H alfox £H XH al1oaI9a oL9.L3oHwoN£Oa
 3 19H3uaoxv,LOA Eumxdaf a19H9ua.LEXCed,LO Wahadu 'OUExdaf aonqua.LEXred.Lo onaL1aoniaoA
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 3 oxxouou aOx3ah1LLUO H Atiwaiaxo ox noiAdx3Ano4 'ada£EU oaodo La Rao Ylox33hH.L110
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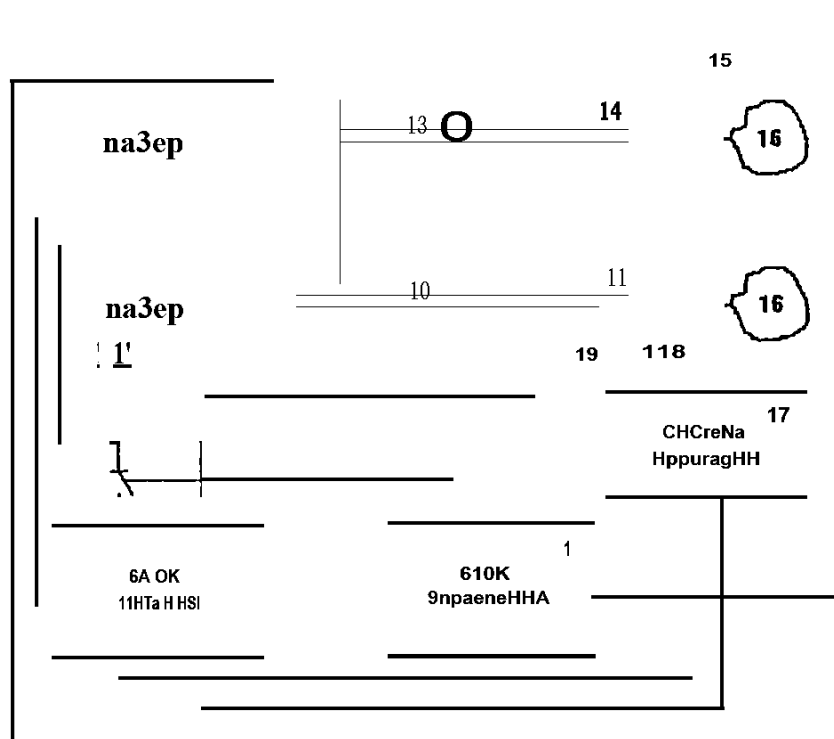
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 3 OHSOUOa 0OX33hH.LUO H 1JWL3H3 otAuo41dH31C3I04i Eda£EU oa0d01.a 1130 I303133hH.LUO
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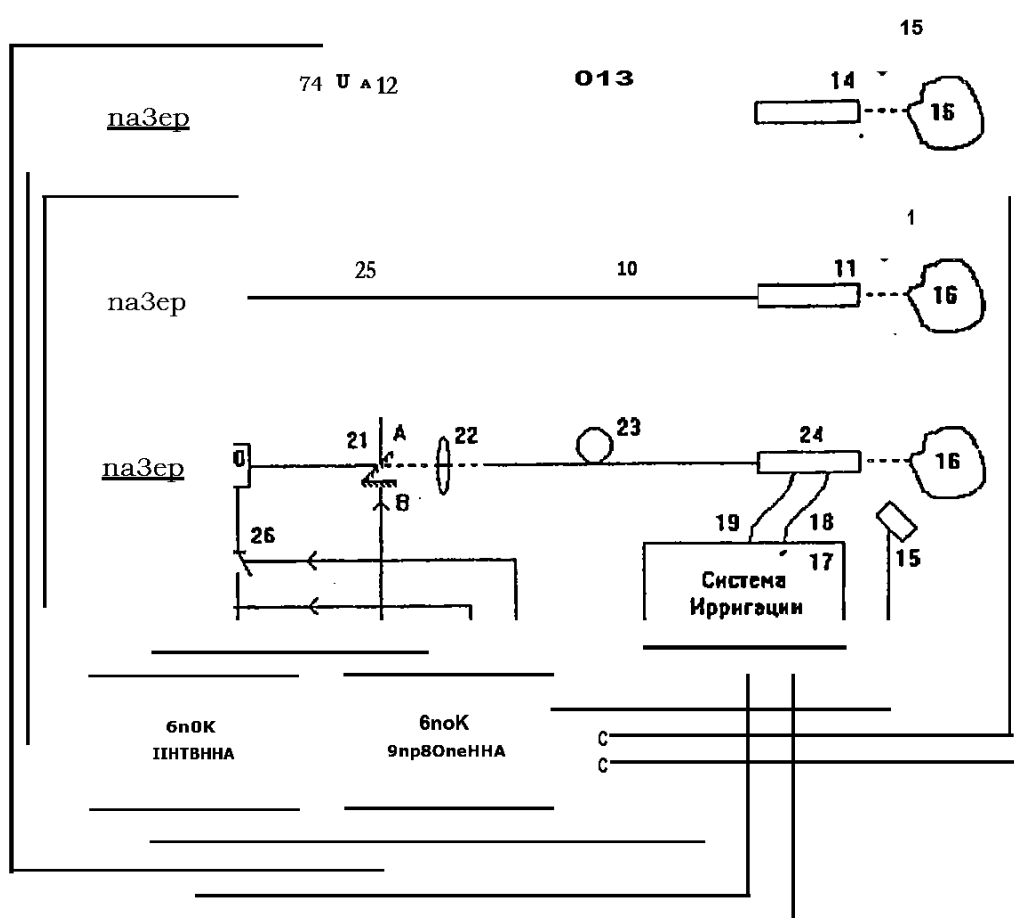
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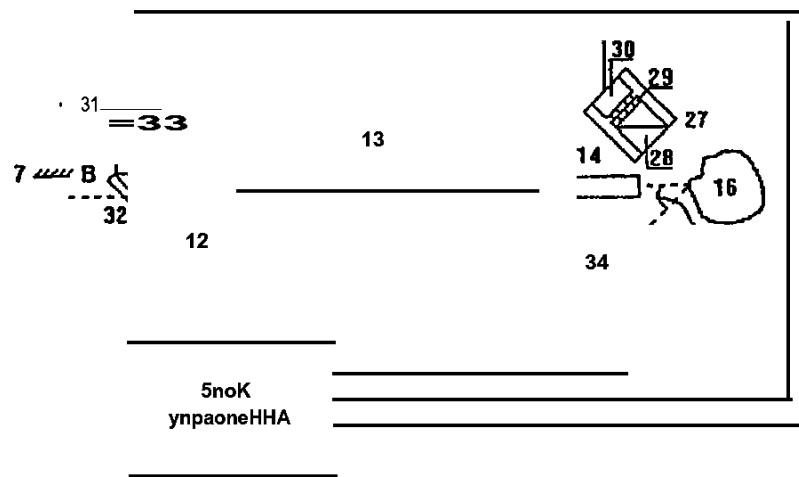
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7. YCTpoCTBO no nn.1 H 2, o'rnnualonweecB TeM. tiro ono J;ononHHTenbno cna6meno cHCpeMOH² opoivemiH 3oHbi o6pa6o'rKH, coCroslllleil H3 ne3epnyapa J~nsl BOJ;bI c BoJ;siHbnM HacoCOM 11 BO3J;pynnop0 KoMnneccopa, C00TBCTCTByIOHVHC BbIXOJ; ы KOTOpbIX o6'beAHHeHbi B HaKOHenHHKaX H 3IB3\$IIOTCII HppIlral[HOHHbIMH BbIXOJ;{aMH yCTpOIACTBa, a BO3J;IYwbII¹ KOMnpCCOp B MCCTC coe nHeHHCI c BO3J;IyX0IIpOBOaamH CHa6?KCH 3IleKTpOMarHHTHbIMH KnanaHamll, nOJ;KnIOHeHHbIMH K BbIXOJ;aM 6noKa ynpaBneHHCI.

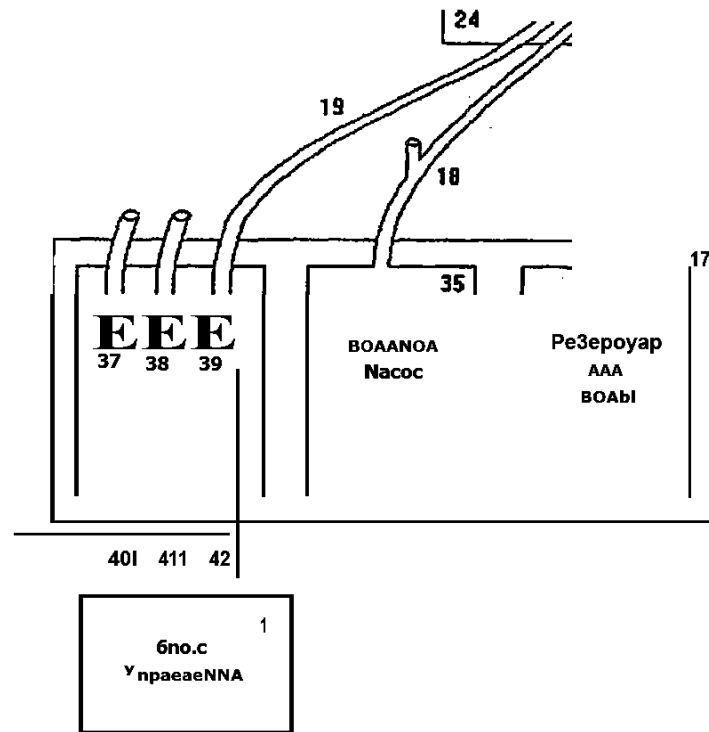
Drawing(s) NepTexzx):



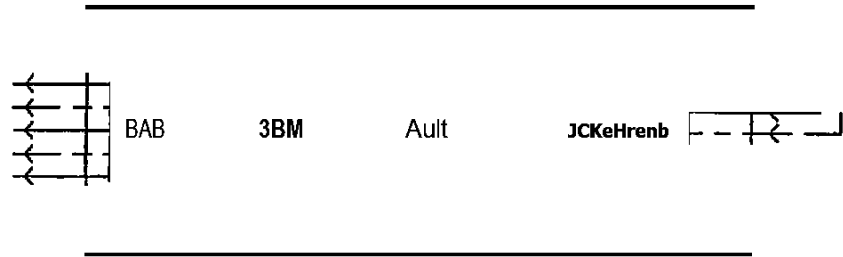




0wr.3



mt~r.4



(Dmr.5